

METHODS OF INTERFACING WITH MULTI-INPUT DEVICES AND MULTI-INPUT DISPLAY SYSTEMS EMPLOYING INTERFACING TECHNIQUES

REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to U.S. Provisional Patent Application No. 61/043,863, filed Apr. 10, 2008, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to methods of interfacing with multi-input devices, including multi-touch input devices, and multi-input display systems employing interfacing techniques.

[0004] 2. Description of the Related Art

[0005] So-called touch screen displays are well known and common in many industries. As an example, most bank ATMs use touch screen displays. As the utility of these types of displays increases, displays within home and business, including televisions and computer monitors, are increasingly becoming touch sensitive.

[0006] Recently, multi-touch input devices are becoming more available for various uses due to advancements in touch sensing technologies, reductions in cost, and other factors. Multi-touch input devices, by definition, are capable of detecting multiple inputs simultaneously. U.S. patent application Ser. Nos. 11/833,908; 12/185,782; 12/182,440; 60/821,325; 60/953,966; and 60/952,709; and U.S. Patent Publication Nos. 2008/0029691A1; 2008/0284925A1; and 2009/0033637A1, all assigned to the assignee of the present application and incorporated herein by reference, identify various technologies and publications within the field, and further describe additional advancements in multi-touch sensing through frustrated total internal reflection.

[0007] Interface control technology, including interfacing techniques, has been widely studied. The following publications explore various concepts, methodologies and techniques in this area: Buxton, W., Hill, R., and Rowley, P., "Issues and Techniques in Touch-Sensitive Tablet Input," Proceedings of the 12th Annual Conference on Computer Graphics and Interactive Techniques SIGGRAPH '85, ACM Press, New York, N.Y., 215-224 (1985); Michael Chen, "A Study in Interactive 3-D Rotation Using 2-D Control Devices," Computer Graphics, Vol. 22, No. 4, 121-129 (1988); K. Shoemake, "ARCBALL: A User Interface for Specifying Three-Dimensional Orientation Using a Mouse," Proceedings of the conference on Graphics interface '92, 151-156 (1992); Ken Hinckley, "Haptic Issues for Virtual Manipulation," A Dissertation Presented to the Faculty of the School of Engineering and Applied Science at the University of Virginia, section 6.1-6.3 (1996), from the website <http://research.microsoft.com/Users/kenh/thesis/front.htm>; Dietz, P. and Leigh, D., "DiamondTouch: A Multi-User Touch Technology," Proceedings of the 14th Annual ACM Symposium on User Interface Software and Technology (Orlando, Fla., Nov. 11-14, 2001), UIST '01, ACM Press, New York, N.Y., 219-226 (2001); Lee, S., Buxton, W. and Smith, K. C., "A Multi-Touch Three Dimensional Touch-Sensitive Tablet," Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (San Francisco, Calif., United States), CHI '85, ACM Press, New York, N.Y., 21-25 (1985); Malik,

S. and Laszlo, J., "Visual Touchpad: A Two-Handed Gestural Input Device," Proceedings of the 6th International Conference on Multimodal Interfaces (State College, Pa., USA, Oct. 13-15, 2004), ICMI '04, ACM Press, New York, N.Y., 289-296 (2004); Rekimoto, J., "SmartSkin: An Infrastructure for Freehand Manipulation on Interactive Surfaces," Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, CHI '02, ACM Press, New York, N.Y., 113-120 (2002); Westerman, W., Elias, J. G., and Hedge, A., "Multi-Touch: A New Tactile 2-D Gesture Interface for Human-Computer Interaction," Proceedings of the Human Factors and Ergonomics Society 45th Annual Meeting (Minneapolis/St. Paul, Minn., October 2001), 632-636 (2001); Wilson, A. D., "TouchLight: An Imaging Touch Screen and Display for Gesture-Based Interaction," Proceedings of the 6th International Conference on Multimodal Interfaces (State College, Pa., USA, Oct. 13-15, 2004), ICMI '04, ACM Press, New York, N.Y., 69-76 (2004); and Wu, M. and Balakrishnan, R., "Multi-Finger and Whole Hand Gestural Interaction Techniques for Multi-User Tabletop Displays," Proceedings of the 16th Annual ACM Symposium on User Interface Software and Technology (Vancouver, Canada, Nov. 2-05, 2003), UIST '03, ACM Press, New York, N.Y., 193-202 (2003), each of which is incorporated herein by reference.

[0008] Various publications explore two-handed input. These include: R. Balakrishnan and K. Hinckley, "Symmetric bimanual interaction," CHI '00: Proceedings of the SIGCHI conference on Human factors in computing systems, 33-40 (2000); R. Balakrishnan and G. Kurtenbach, "Exploring bimanual camera control and object manipulation in 3D graphics interfaces," CHI '99: Proceedings of the SIGCHI conference on Human factors in computing systems, 56-63 (1999); Y. Guiard, "Asymmetric division of labor in human skilled bimanual action: The kinetic chain as a model," Journal of Motor Behavior, 19(4):486-517 (1987); K. Hinckley, R. Pausch, J. C. Goble, and N. F. Kassell, "Passive real-world interface props for neurosurgical visualization," CHI '94: Proceedings of the SIGCHI conference on Human factors in computing systems, 452-458 (1994); G. Kurtenbach, G. Fitzmaurice, T. Baudel, and B. Buxton, "The design of a GUI paradigm based on Tablets, Two-hands, and Transparency," CHI '97: Proceedings of the SIGCHI conference on Human factors in computing systems, 35-42 (1997); I. Llamas, B. Kim, J. Gargus, J. Rossignac, and C. D. Shaw, "Twister: a space-warp operator for the two-handed editing of 3D shapes," ACM Transactions on Graphics, 22(3):66 3-668 (2003); and R. Zeleznik, A. Forsberg, and P. Strauss, "Two pointer input for 3D interaction," SI3D '97: Proceedings of the 1997 symposium on Interactive 3D graphics, 115-120 (1997). Each of these publications is incorporated herein by reference.

[0009] Recent patent publications in this field further include U.S. Patent Publication Nos. 2006/0026521, 2006/0026535, 2006/0053387, 2006/0085757, 2006/0033724, 2006/0161870, 2006/0161871, and 2006/0026535, each of which is incorporated herein by reference. Moreover, U.S. Patent Publication Nos. 2008/0180404A1, 2008/0180405A1 and 2008/0180406A1, assigned to the assignee of the present application and incorporated fully herein by reference, describe particular advancements in both 2D and 3D object control and 3D globe view control, among other things.

SUMMARY OF THE INVENTION

[0010] Human interface techniques that take full advantage of the multi-input capability of multi-input sensing technol-